Twenty-First Century Spectroscopic Data for Determinations of Interstellar Ice Abundances

Completed Technology Project (2014 - 2017)

Project Introduction

The molecular chemistry of interstellar and circumstellar environments consists of a complex interplay between gas- and solid-phase processes. An important step in unraveling this chemistry has been the observation and identification of gas-phase molecules, mainly by radio and microwave observations. Nearly 200 interstellar and circumstellar gas-phase molecules are known, but only about 10 identifications, mostly from infrared (IR) studies, have been made of solid-phase species, usually termed 'ices'. Determining the abundances of icy molecules has been a continual challenge due to the lack of appropriate laboratory measurements of spectral band strengths, optical constants, refractive indices, and ice densities. Our research group is now engaged in two new laboratory programs for just such measurements. In one program we measure IR optical constants (n and k) for molecules found in molecular ices. Our second new laboratory program focuses on densities and refractive indices, which are required for generating optical constants and spectral band strengths from laboratory IR data. This combination of research efforts within a single facility provides an unusual, if not unique, opportunity for producing the lab data required for more-accurate analysis and interpretation of Spitzer, and other, observations of interstellar ices. In spite of a general belief that such lab results may already be available, a careful literature search quickly reveals significant, surprising, and stunning gaps and deficiencies. The current situation is paradoxical in that twenty-first century spectra of astronomical ices near 10 K are being analyzed for molecular abundances using room-temperature physical properties and results from vacuum-tube dispersive spectrometers and mechanical planimeters. Here we propose a systematic effort to bring the lab data into the twenty-first century through the measurement of IR spectra and optical constants, refractive indices, and densities of several known interstellar ices and selected mixtures involving them. We also will study the degree to which data for individual covalently-bonded molecules can be combined and used to interpret the spectra of mixed-molecular ices.

Twenty-First Century Spectroscopic Data for Determinations of Interstellar Ice Abundances

Table of Contents

Organizational Responsibility

Responsible Mission Directorate:

Science Mission Directorate (SMD)

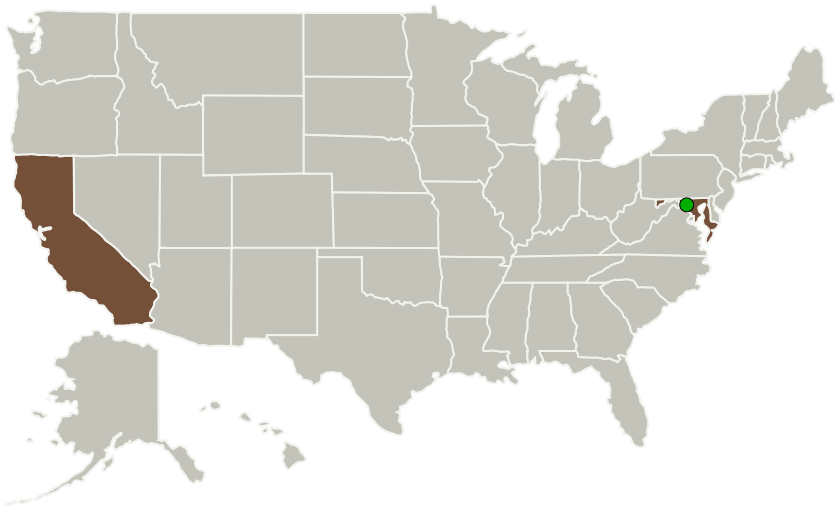
Responsible Program:

Astrophysics Research and Analysis

Twenty-First Century Spectroscopic Data for Determinations of Interstellar Ice Abundances

Completed Technology Project (2014 - 2017)

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Goddard Space Flight Center(GSFC)	Supporting Organization	NASA Center	Greenbelt, Maryland

Primary U.S. Work Locations	
California	Maryland

Project Management

Program Director:

Michael A Garcia

Program Manager:

Dominic J Benford

Principal Investigator:

Reggie L Hudson

Co-Investigators:

Mark J Loeffler
Perry A Gerakines
Abraham C Boogert

Technology Areas

Primary:

- TX01 Propulsion Systems
  - TX01.3 Aero Propulsion
    - TX01.3.11 Engine Icing

Target Destination

Outside the Solar System